IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re PATENT APPLICATION of

Inventor(s): Hiroyuki Tomita

Appln. No.: 10/695,534 Art Unit: 3744

Filed: October 28, 2003 Examiner: B. Clayton McCraw, Esq.

Title: VEHICLE AIR CONDITIONER

VERIFIED TRANSLATION OF PRIORITY DOCUMENT

The undersigned, of the below address, hereby certifies that he/she well knows both the English and Japanese languages, and that the attached is an accurate translation into the English language of the Certified Copy, filed for this application under 35 U.S.C. Section 119 and/or 365, of:

Application No.	Country	Date Filed
2002-318315	Japan	October 31, 2002

Signed this 6th day of March, 2006.

Signature: [signature]

Name: Shun-Ji Jin

Address: 16-406 Honji-so, 1701 Honjigaoka,Moriyama-ku, Nagoya-city,
Aichi-pref., 463-0031, JAPAN

JAPAN PATENT OFFICE

This is to certify that the annexed is a true copy of the following application as filed with this Office.

Date of Application: October 31, 2002

Application Number: Japanese Patent Application No. 2002-318315

[ST. 10/C]: [JP2002-318315]

Applicant(s): DENSO CORPORATION

September 8, 2003

Commissioner,
Japan Patent Office Yasuo Imai

Certificate Issuance NO. 2003-3073345

[Name of Document]	Patent Application
[Reference Number]	PSN594
[Filing Date]	October 31, 2002
[Address]	Commissioner of Patent Office
[International Patent Classification]	B60H 1/00

[Inventor]

[Address] c/o DENSO CORPORATION
1-1 SHOWA-CHO, KARIYA-CITY, AICHI-PREF.

[Name] Hiroyuki Tomita

[Applicant]

[Identification Number]	000004260
[Name]	DENSO CORPORATION

[Agent]

[Identification Number]	100106149
[Patent Attorney]	
[Name]	Kazuyuki Yahagi
[Telephone Number]	052-220-1100

[Indication of fees]

[Prepayment Book Number]	010331
[Amount of Payment]	21000 yen

[List of Submitted Articles]

[Name of Article]	Specification	1
[Name of Article]	Drawings	1
[Name of Article]	Abstract	1

[Need of Proof] Needed

[Name of the Document] SPECIFICATION

[Title of the Invention] VEHICLE AIR CONDITIONER

[Claimed Scope for Patent]

[Claim 1] An air conditioner for a vehicle, comprising:

an operation portion (22b) provided in an air conditioning unit (20), the operation portion (22b) being operated in air conditioning;

an environmental-condition detecting device (34, 37) for detecting an environmental condition of the vehicle;

a control characteristic memory device (31) for storing a control characteristic showing a relationship between the environmental condition detected by the environmental-condition detecting device (34, 37) and a control value applied to the operation portion (22b); and

a control unit (30) for controlling operation of the operation portion (22b) based on the control characteristic stored in the control characteristic memory device (31), by using the environmental condition detected by the environmental-condition detecting device (34, 37),

wherein the environmental-condition detecting device (34, 37) includes a surface temperature detecting device (37) for detecting one of an inner surface temperature of the passenger compartment and a surface temperature of a passenger, in each detection area of the passenger compartment.

[Claim 2] The air conditioner according to claim 1, wherein the control unit (30) controls the operation portion (22b) by using the surface temperature detected by the surface temperature

detecting device (37) in each detection area of the passenger compartment, so as to perform air conditioning for every passenger seat.

[Claim 3] The air conditioner according to any one of claims 1, 2, further comprising a manual setting device (43) for manually setting the control value applied to the operation portion (22b),

wherein the control unit (30) has a control-characteristic changing means (S340) for changing the control characteristic stored in the control characteristic memory device (31) when the control value is manually changed by the manual setting device (43) in a given environmental condition of the control characteristic.

[Claim 4] The air conditioner according to any one of claims 1-3, wherein the control characteristic memory device (31) stores a relationship between the solar radiation thermal load, obtained based on the surface temperature detected by the surface temperature detecting device (37) in each detection area, and the control value applied to the operation portion (22b), as the control characteristic.

[Claim 5] The air conditioner according to any one of claims 1-3, wherein:

the environmental-condition detecting device (34, 36, 37) includes a solar radiation amount detecting device (36) for detecting a solar radiation amount radiated into the passenger compartment; and

the control characteristic memory device (31) stores a relationship between the solar radiation thermal load, obtained

based on the surface temperature detected by the surface temperature detecting device (37) in each detection area and the solar radiation amount detected by the solar radiation amount detecting device (36), and the control value applied to the operation portion (22b), as the control characteristic.

[Claim 6] The air conditioner according to claim 3, wherein:

the operation portion (22b) includes an air temperature adjusting device (22b) for adjusting a temperature of conditioned air to be blown into the passenger compartment;

the environmental-condition detecting device (34, 36, 37) further includes a solar radiation amount detecting device (36) for detecting a solar radiation amount radiated into the passenger compartment; and

the control characteristic memory device (31) stores a relationship between a control value applied to the air temperature adjusting device (22b) and a first solar radiation thermal load obtained based on the solar radiation amount detected by the solar radiation amount detecting device (36) and the surface temperature detected by the surface temperature detecting device (37) in each detection area of the passenger compartment, as the control characteristic.

[Claim 7] The air conditioner according to claim 6, wherein:

the operation portion (22b, 27) further includes a blower (27) for blowing conditioned air into the passenger compartment; and

the control characteristic memory device (31) stores a relationship between a control value applied to the blower (27)

and a second solar radiation thermal load obtained based on the solar radiation amount detected by the solar radiation detecting device (36), as the control characteristic.

[Claim 8] The air conditioner according to any one of claims 1-7, wherein the surface temperature detecting device (37) is an infrared rays sensor (37) for detecting an infrared-ray intensity in each detection area.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention]

The present invention relates to a vehicle air conditioner which controls a temperature and the like of conditioned air to be blown into a passenger compartment in accordance with an environmental condition of the vehicle, such as solar radiation.

[0002]

[Prior Art]

In a conventional vehicle air conditioner, a temperature, an amount and the like of conditioned air to be blown into a passenger compartment are controlled in accordance with predetermined control characteristics, based on an environmental condition such as detection values of an outside air temperature sensor, an inside air temperature sensor and a solar radiation sensor. For example, in a vehicle air conditioner disclosed in the below-described patent document 1, a control unit performs a learning air-conditioning control by changing the control characteristics for every user.

[0003]

In the vehicle air conditioner having a learning air-conditioning control, the control characteristics are changed based on an air-conditioning setting state manually set by a passenger. Specifically, when an air outlet temperature is manually changed by the passenger in an air-conditioning control performed based on the predetermined control characteristics, it is determined that the predetermined control characteristics do not reflect the passenger's preference. In this case, the control characteristics are changed based on the manually set state.

[0004]

[Patent Document 1]

JP-A-64-43847

[0005]

[Problem to be Solved]

However, in the above vehicle air conditioner, even when a solar radiation amount detected by the solar radiation sensor does not change, if a solar radiation condition (solar radiation direction and the like) changes, thermal feeling of the passenger is changed. Therefore, in this case, uncomfortable feeling is sometimes given to the passenger.

[0006]

Here, the vehicle air conditioner having the learning air-conditioning control performs air conditioning reflecting passenger's preference. In this vehicle air conditioner, even when the solar radiation amount detected by the solar radiation sensor does not change, thermal feeling of the passenger may

frequently change (e.g., a direction of sunlight radiated to a passenger on a driver seat frequently changes). In this case, uncomfortable feeling is sometimes given to the passenger, regardless of the operation of the learning air-conditioning control. Therefore, in this case, manual operation is required to be frequently performed.

[0007]

In view of the above-described problem, it is an object of the present invention to provide a vehicle air conditioner capable of reducing uncomfortable feeling given to a passenger regardless of a solar radiation condition.

[0008]

[Problem to be Solved]

In order to attain the above object, in the present invention defined in claim 1, an air conditioner for a vehicle includes an operation portion (22b), an environmental-condition detecting device (34, 37), a control characteristic memory device (31) and a control unit (30). The operation portion (22b) is provided in an air conditioning unit (20), and is operated in air conditioning. The environmental-condition detecting device (34, 37) detects an environmental condition of the vehicle. The control characteristic memory device (31) stores a control characteristic showing a relationship between the environmental condition detected by the environmental-condition detecting device (34, 37) and a control value applied to the operation portion (22b). The control unit (30) controls operation of the operation portion (22b) based on the control characteristic stored in the control characteristic

memory device (31), by using the environmental condition detected by the environmental-condition detecting device (34, 37). In the air conditioner, the environmental-condition detecting device (34, 37) includes a surface temperature detecting device (37) for detecting one of an inner surface temperature of the passenger compartment and a surface temperature of a passenger, in each detection area of the passenger compartment.

[0009]

Thus, the air conditioning can be performed by controlling the operation of the operation portion (22b) based on both of the solar radiation amount and the solar radiation direction. Therefore, uncomfortable feeling given to the passenger can be reduced, without respect to the solar radiation condition.

[0010]

In the present invention defined claim 2, the control unit (30) controls the operation portion (22b) by using the surface temperature detected by the surface temperature detecting device (37) in each detection area of the passenger compartment, so as to perform air conditioning for every passenger seat.

[0011]

Thus, the air conditioning can be performed for each passenger, thereby reducing uncomfortable feeling given to the passenger without respect to the solar radiation condition.

[0012]

In the present invention defined in claim 3, the air conditioner according to any one of claims 1, 2 further includes a manual setting device (43) for manually setting the control value applied to the

operation portion (22b). In the air conditioner, the control unit (30) has a control-characteristic changing means (S340) for changing the control characteristic stored in the control characteristic memory device (31) when the control value is manually changed by the manual setting device (43) in a given environmental condition of the control characteristic.

[0013]

Thus, when the control value is manually changed in accordance with passenger's preference, this change is stored in the control characteristic memory device (31), thereby learning the control characteristic reflecting the passenger's preference in a given solar radiation condition. Accordingly, uncomfortable feeling given to the passenger can be reduced without respect to the solar radiation condition.

[0014]

In the present invention defined in claim 4, the control characteristic memory device (31) stores a relationship between the solar radiation thermal load, obtained based on the surface temperature detected by the surface temperature detecting device (37) in each detection area, and the control value applied to the operation portion (22b), as the control characteristic.

[0015]

Thus, the operation of the operation portion (22b) can be controlled in accordance with a given solar radiation condition without adopting a detecting device for directly detecting a solar radiation amount.

[0016] In the present invention defined in claim 5, the

environmental-condition detecting device (34, 36, 37) includes a solar radiation amount detecting device (36) for detecting a solar radiation amount radiated into the passenger compartment. Further, the control characteristic memory device (31) stores a relationship between the solar radiation thermal load, obtained based on the surface temperature detected by the surface temperature detecting device (37) in each detection area and the solar radiation amount detected by the solar radiation amount detecting device (36), and the control value applied to the operation portion (22b), as the control characteristic.

[0017]

Thus, since the solar radiation thermal load can be calculated in each detection area in the passenger compartment, the air conditioning in each given detection area can be performed without respect to solar radiation condition.

[0018]

In the present invention defined in claim 6, the operation portion (22b) includes an air temperature adjusting device (22b) for adjusting a temperature of conditioned air to be blown into the passenger compartment. Further, the environmental-condition detecting device (34, 36, 37) further includes a solar radiation amount detecting device (36) for detecting a solar radiation amount radiated into the passenger compartment. The control characteristic memory device (31) stores a relationship between a control value applied to the air temperature adjusting device (22b) and a first solar radiation thermal load obtained based on the solar radiation amount detected by the solar radiation amount

detecting device (36) and the surface temperature detected by the surface temperature detecting device (37) in each detection area of the passenger compartment, as the control characteristic.

[0019]

Thus, since the solar radiation thermal load can be calculated in each detection area in the passenger compartment, the air conditioning in each given area can be performed without respect to solar radiation condition.

[0020]

In the present invention defined in claim 7, the operation portion (22b, 27) further includes a blower (27) for blowing conditioned air into the passenger compartment. Further, the control characteristic memory device (31) stores a relationship between a control value applied to the blower (27) and a second solar radiation thermal load obtained based on the solar radiation amount detected by the solar radiation detecting device (36), as the control characteristic.

[0021]

According to the studies of the present inventors, the passenger's preference for an air amount blown by the blower (27), that is, the conditioned-air outlet amount is influenced by not only the thermal feeling reduction of the passenger but also sound noises of the blown air and the likes. Accordingly, when an air outlet amount is controlled in accordance with the solar radiation in each detection area, uncomfortable feeling given to the passenger sometimes increases. On the other hand, according to the present invention defined in claim 7, uniform air-outlet control can be

readily performed without respect to the solar radiation condition in each detection area.

[0022]

In the present invention defined in claim 8, the surface temperature detecting device (37) is an infrared rays sensor (37) for detecting an infrared-ray intensity in each detection area.

[0023]

Accordingly, the surface temperature detecting device (37) is not required to be provided for each detection area in the passenger compartment.

[0024]

Here, reference numerals in parentheses of the above devices correspond to specific devices described in the later-described embodiments, respectively.

[0025]

[Embodiments of the Invention]

Preferred embodiments of the present invention will be described hereinafter with reference to the appended drawings.

[0026]

(First Embodiment)

FIG. 1 is a schematic diagram showing a vehicle air conditioner 10 according to the first embodiment of the present invention.

[0027]

As shown in FIG. 1, a vehicle air conditioner 10 includes an air conditioning unit 20. The air conditioning unit 20 is disposed in front of an instrument panel positioned on a front side in a passenger compartment. An inside-outside air switching

door 22a is disposed in the air conditioning unit 20 at the most upstream portion. The inside-outside air switching door 22a switches an inside-outside air introduction mode, and is disposed at a portion separated to an outside air inlet and an inside air inlet. The switching door 22a is rotatably moved by an actuator (not shown), to change a flow ratio between an inside air amount and an outside air amount introduced into the air conditioning unit 20.

[0028]

A blower 27, constructed of a blower motor 24 and a blower fan 23 fixed to the blower motor 24, sucks air into the air conditioning unit 20. The blower 27 blows the sucked air to a downstream side in the air conditioning unit 20, and into a passenger compartment. An evaporator 25 and a heater core 26 are provided downstream of the blower 27.

[0029]

The evaporator 25 is connected to a compressor (not shown) and the like, to construct a refrigerant cycle, and cools air passing through the evaporator 25. Engine-cooling water is circulated into the heater core 26, so that the heater core 26 heats air passing therethrough.

[0030]

An air mixing door 22b is provided upstream of the heater core 26, and open degree of the air mixing door 22b is adjusted by an actuator (not shown). In this way, a flow ratio between air passing through the heater core 26 and air bypassing the heater core 26 is adjusted, thereby controlling a temperature of air

to be blown into the passenger compartment. As the open degree of the air mixing door 22b becomes smaller, the air temperature becomes lower. The air mixing door 22b is an operation portion in the present embodiment, and is also an air temperature adjusting device for adjusting temperature of air to be blown into the passenger compartment.

[0031]

A defroster door 22c, a face door 22d and a foot door 22e, for switching an air outlet mode, are provided in the air conditioning unit 20 at the most downstream side. The doors 22c, 22d, 22e are operated by an actuator (not shown), so that conditioned air is blown into the passenger compartment in each air outlet mode.

[0032]

An amount of air blown by the blower 27 and open degrees of the doors 22a, 22b, 22c, 22d, 22e are controlled by a control unit 30. Specifically, the blower 27 and the doors 22a, 22b, 22c, 22d, 22e are controlled based on signals output from the control unit 30 through a voltage controller (not shown) and an actuator (not shown).

[0033]

The control unit 30 includes a central processing unit (not shown), a memory device 31 as a control characteristics storing device, and the like.

[0034]

The memory device 31 stores initial control characteristics, specifically, an inside-outside air mode control characteristic

of the switching door 22a, an open degree control characteristic of the air mixing door 22b, an air-outlet mode control characteristic of the doors 22c, 22d, 22e and a voltage control characteristic applied to the blower 27. The control characteristics are predetermined so as to be changed in accordance with such as a target air temperature TAO blown into the passenger compartment.

[0035]

An environmental condition, influencing the air conditioning in the passenger compartment, is output from environmental-condition detecting devices as detection signals. The detection signals are input to the control unit 30. The environmental-condition detecting devices includes an outside air temperature sensor 34 for detecting an outside air temperature, a water temperature sensor 35 for detecting a temperature of engine-cooling water, an infrared rays sensor (IR sensor) 37 described later, a temperature sensor (not shown) for detecting an air temperature directly after passing through the evaporator 25 and the like.

[0036]

Operation signals output from an operation portion 40 are input to the control unit 30. The operation portion 40 includes an automatic switch 41 for setting an automatic control, an air-outlet mode switch 42 for setting an air outlet mode (face, bi-level, foot, foot-defroster and defroster modes), a temperature setting switch 43, an air amount switch 44, an inside-outside air mode switch (not shown) and the like.

[0037]

The temperature setting switch 43 is for manually setting a temperature of conditioned air to be blown from the air conditioning unit 20 into the passenger compartment. In the present embodiment, the temperature setting switch 43 is constructed only with an up switch for increasing the set temperature and a down switch for reducing the set temperature, and does not have a set temperature display. In this way, the conditioned air temperature can be set by the temperature setting switch 43 in accordance with passenger's preference without a passenger preconception due to the set temperature display. The temperature setting switch 43 is a control-value manual setting device in the present embodiment.

[0038]

Here, the IR sensor 37 used as one of the environmental-condition detecting devices will be described. The IR sensor 37 is disposed at a front-upper portion in the passenger compartment to detect area temperatures. As shown in FIG. 2, an inner space of the passenger compartment is separated into plural detection areas (e.g., 32 areas enclosed by one-dot chain lines shown in FIG. 2), and infrared-ray intensity in each detection area is detected by the IR sensor 37. Thus, the IR sensor 37 detects a temperature of an inner surface (an interior surface and a glass inner surface) of the passenger compartment and a surface temperature of the passenger in each detection area, and the detected temperature of the IR sensor 37 is input to the control unit 30. The IR sensor 37 is a surface temperature

detecting device in the present embodiment.

[0039]

Next, operation of the vehicle air conditioner 10 having the above construction will be described.

[0040]

FIG. 3 is a flow diagram showing all of schematic control operation. As shown in FIG. 3, the control unit 30 starts a control process at step S100 by turning on an ignition switch of the vehicle, and initializes conversion coefficients, flags and the likes at step S110.

[0041]

At step S150, environmental conditions are input from the outside air temperature sensor 34, the water temperature sensor 35, the IR sensor 37 and the like, and switch operation states are also input from the operation portion 40.

[0042]

At step S200, the target air temperature TAO of air to be blown into the passenger compartment is calculated by using the following formula (1) based on various environmental conditions and the likes input at step S150.

[0043]

[Formula 1]

$$TAO = Kset \times Tset - Kr \times Tr - Kam \times Tam - Ks \times Ts + C$$

Wherein, Kset, Kr, Ks are coefficients, and C is a constant. Tset is a set temperature, Tr is an inside air temperature, and Ts is a solar radiation amount.

[0044]

In the present embodiment, the inside air temperature Tr is an average value of temperatures in the detection areas detected by the IR sensor 37. Therefore, the inside air temperature Tr can be detected without using an inside air temperature sensor. However, an inside air temperature sensor can be provided. In this case, the target air temperature TAO can be calculated based on the inside air temperature detected by the inside air temperature sensor.

[0045]

Further, the solar radiation amount Ts is calculated by using the following formula (2) based on the air temperatures in the detection areas, detected by the IR sensor 37.

[0046]

[Formula 2]

$$Ts = Tdr - Tr - Tam$$

Wherein, Tdr is an average temperature around a window at a driver seat (in two detection areas 371, 372 in FIG. 2 in this example). A detection example of the IR sensor 37 is shown in FIG. 5. In this case, Tr is defined by the average value of detected temperatures in all of the detection areas, and Tdr is defined by the average value of air temperatures of 28.7°C, 29.0°C corresponding to the two detection areas 371, 372 shown in FIG. 2. In this way, thermal loads due to the solar radiation can be calculated without using a solar radiation sensor.

[0047]

Then, at step S300, an open degree of the air mixing door 22a is calculated based on the target air temperature TAO in

accordance with the open-degree control characteristic of the air mixing door 22a beforehand stored in the memory device 31. The air mixing door 22a is controlled to have the calculated open degree by an actuator (not shown), thereby controlling the temperature of conditioned air to be blown from each air outlet into the passenger compartment.

[0048]

Further, at step S300, when the passenger (in this example, a driver frequently riding in the vehicle) manually operates the temperature setting switch 43 in accordance with preference of the passenger, a relationship between the environmental condition and Tset is learned in accordance with this manual operation. In this way, the learning control is suitably performed so that the air temperature blown into the passenger compartment is controlled at a preferred temperature.

[0049]

Here, the air mixing control at step S300 is described in detail with reference to a flow diagram shown in FIG. 4.

[0050]

At step S310, it is determined whether Tset is manually set and changed by manually operating the temperature setting switch 43. When it is determined at step S310 that Tset is not manually set, the target air temperature TAO is calculated at step S320 based on Tset (refer to FIG. 6), stored in the memory device 31, corresponding to an outside air temperature and the thermal loads due to the solar radiation at this time. Further, at step S320, a target open degree SW of the air mixing door 22b corresponding

to the calculated TAO is calculated as a control value based on a control characteristic stored in the memory device 31. At step S330, the calculated SW is output, and the operation of the air mixing door 22b is controlled.

[0051]

On the other hand, when it is determined at step S310 that the Tset is manually set, the manually set Tset is learned at step S340. As shown in FIG. 6, the set temperature Tset, stored in the memory device 31, corresponding to a thermal load due to the solar radiation and an outside air temperature at this time is changed to the manually set temperature Tset.

[0052]

At step S350, the target air temperature TAO is calculated based on the changed set temperature Tset described above, and the target open degree SW of the air mixing door 22b corresponding to the calculated target air temperature TAO is calculated based on the control characteristic stored in the memory device 31. At step S330, the target open degree SW is output so that the operation of the air mixing door 22b is controlled. A control operation at step S340 is a control characteristic changing means in the present embodiment.

[0053]

After the air mixing control at step S300 is performed, a voltage applied to the blower 27 is calculated based on the target air temperature TAO and the like in accordance with a voltage control characteristic stored in the memory device 31 at step S400. Then, the calculated voltage is applied to the blower 27

through a drive circuit (not shown), thereby driving the blower 27 and controlling the amount of conditioned air to be blown into the passenger compartment.

[0054]

At step S500, the inside-outside air mode is determined based on the target air temperature TAO in accordance with an inside-outside air mode control characteristic stored in the memory device 31. Then, an actuator (not shown) for driving the switching door 22a is controlled to be driven.

[0055]

At step S600, the air outlet mode corresponding to the target air temperature TAO is determined based on an air-outlet mode control characteristic stored in the memory device 31. Then, an actuator (not shown) for driving the defroster door 22c, the face door 22d and the foot door 22e is controlled to be driven.

[0056]

At steps S400, S500, S600, when the air blowing amount, the inside-outside air mode and the air outlet mode are manually selected, the blower 27 and the doors 22a, 22c-22d are controlled to the manually selected control positions.

[0057]

At step S700, the compressor (not shown) is controlled. Thereafter, the control step is returned to step S150 where various signals are input, and the air-conditioning control from step S150 to step S700 is repeated.

[0058]

In the above-described construction, the air temperature

to be blown into the passenger compartment can be changed based on the solar radiation condition in each detection area, that is, based on the solar radiation amount and the solar radiation direction. Accordingly, uncomfortable feeling given to the passenger (driver in this example) can be reduced, without respect to the solar radiation condition (the solar radiation amount and the solar radiation direction).

[0059]

When the set temperature is changed in accordance with the passenger's preference, this change is stored in the memory device 31 of the control unit 30, thereby learning the air-conditioning characteristic reflecting the passenger's preference in a given solar radiation condition. Accordingly, even if the solar radiation condition is changed, uncomfortable feeling given to the passenger can be reduced, and temperature setting operation can be restricted from being frequently performed due to solar radiation direction.

[0060]

In the vehicle air conditioner 10 according to the present embodiment, uncomfortable feeling given to the driver is reduced while an air temperature in the entire passenger compartment can be controlled at a set temperature. However, when the vehicle air conditioner 10 controls air temperatures independently at right and left sides in the passenger compartment, or independently at right, left, front and rear sides therein, the control unit 30 receives sensor signals of surface temperatures in detection areas from the IR sensor 37. In this way, air-conditioning

operation can be performed for every passenger seat, thereby reducing uncomfortable feeling given to not only the driver but also the other passengers.

[0061]

(Second Embodiment)

Next, the second embodiment will be described with reference to FIG. 7. In the second embodiment, the construction of the environmental-condition detecting devices is different from that in the first embodiment. In the second embodiment, the same portions as in the first embodiment are indicated by the same reference numerals, respectively, and description thereof is eliminated.

[0062]

As shown in FIG. 7, in the present embodiment, a solar radiation sensor 36 is provided as an environmental-condition detecting device, and is a solar radiation detecting device for detecting a solar radiation amount radiated into the passenger compartment. The solar radiation sensor 36 is the so-called 1D solar radiation sensor for detecting only a solar radiation amount. Although not shown in the drawing, the air conditioning unit 20 performs right-left and front-rear independent control (independent air-conditioning control for every passenger seat) in the present embodiment.

[0063]

The target air temperature TAO to be blown from an air outlet corresponding to each passenger seat, is calculated by using the solar radiation amount Ts corresponding to each passenger seat.

The solar radiation amount Ts, corresponding to each passenger seat, is calculated based on the surface temperature in each detection area detected by the IR sensor 37 and the solar radiation amount detected by the solar radiation sensor 36. For example, the solar radiation amount Tsdr, used for calculating the target air temperature TAO to be blown to the driver seat, is the product of the solar radiation amount Tso detected by the solar radiation sensor 36 and the predetermined ratio. Here, the predetermined ratio is a ratio of the difference between the driver seat temperature and the average inside air temperature Tr to the sum of differences between the passenger seat temperatures and the average inside air temperature Tr.

[0064]

Thus, an accurate solar radiation thermal load can be obtained for every passenger seat by using the solar radiation amount Tso detected by the solar radiation sensor 36, to be weighted to each passenger seat.

[0065]

The air-conditioning control as in the first embodiment is performed based on the solar radiation thermal load obtained in this way. Therefore, the air temperature to be blown into the passenger compartment can be changed for every passenger seat (every area in the passenger compartment in the front-rear and right-left directions) in accordance with the solar radiation condition such as the solar radiation amount and the solar radiation direction. Accordingly, the uncomfortable feeling given to the passenger can be reduced regardless of the solar radiation

condition (the solar radiation amount and the solar radiation direction).

[0066]

When the set temperature is changed in accordance with a passenger's preference, the control unit 30 stores this change in the memory device 31, thereby learning the air-conditioning characteristic reflecting the passenger's preference in a given solar radiation condition for every passenger seat. Accordingly, even if the solar radiation condition is changed, the uncomfortable feeling given to the passenger can be reduced, and the temperature setting operation can be restricted from being frequently performed.

[0067]

(Third Embodiment)

The third embodiment will be described with reference to FIGS. 8, 9. In the third embodiment, the air blowing amount is also learned and controlled. In the third embodiment, the portions similar to the first and second embodiments are indicated by the same reference numerals respectively, and description thereof is eliminated.

[0068]

Since a passenger's preference relative to the air blowing amount is different for every passenger, it is difficult to set the voltage applied to the blower 27 (i.e., air blowing amount) by using a uniformly voltage control characteristic. When the air amount switch 44 is manually switched by a passenger, this manual switch operation is leaned in the voltage control

characteristic, thereby controlling the air blowing amount in accordance with the passenger's preference, and suitably performing the learning control. The air amount switch 44 is a control-value manual setting device in the present embodiment.

[0069]

FIG. 8 is a flow diagram showing a control flow of the blower voltage control performed by the control unit 30 in the present embodiment (corresponding to step S400 shown in FIG. 3).

[0070]

At step S410 shown, it is determined whether the air blowing amount is manually changed by operating the air amount switch 44. When it is determined at step S410 that the air blowing amount is not manually changed, the voltage applied to the blower 27 is calculated by using a voltage control characteristic stored in the memory device 31, corresponding to the solar radiation thermal load and the outside air temperature at this time. At step S430, the calculated voltage is output to the blower 27, thereby controlling the air blowing amount of the blower 27.

[0071]

On the other hand, when it is determined at step S410 that the air blowing amount is manually changed, this change is learned at step S440. As shown in FIG. 9(a), a voltage characteristic, in an area corresponding to the solar radiation thermal load and the outside air temperature at this time, is changed to the manually changed voltage. For example, a stored voltage is changed so as to be approximated to the manually changed voltage by using the least square approximation technique. In this way, as shown

in FIG. 9(b), the initial characteristic 271 is changed to the learned characteristic 272, and the learned characteristic 272 is stored in the memory device 31.

[0072]

Further, as the solar radiation amount (solar radiation thermal load) increases, the lowest level line 273 of the voltage is increased. However, the lowest level line 273 is not changed by the above-described learning.

[0073]

At step S450, based on the changed voltage characteristic described above, the voltage applied to the blower 27 is calculated to correspond to the environmental condition at this time. At step S430, the calculated voltage is output, thereby controlling the operation of the blower 27. Step S440 is a control characteristic changing means in the present embodiment.

[0074]

In the present embodiment, as in the second embodiment, the solar radiation thermal load (first solar radiation thermal load) can be accurately obtained for every passenger seat by using the solar radiation amount Tso detected by the solar radiation sensor 36, weighted to each passenger seat. In this case, relative to the solar radiation amount Tso, a weighted amount (a distributed amount) is added for each passenger seat in accordance with the solar radiation direction and like obtained from the detection results (temperature distribution) of the IR sensor 37. Therefore, the air mixing door 22b is controlled based on the accurate solar radiation thermal load, and the air temperature can be changed

for every passenger (every area in the front-rear and right-left directions in the passenger compartment).

[0075]

On the other hand, in the control of the voltage applied to the blower 27, the solar radiation load (second solar radiation thermal load) is obtained from the solar radiation amount detected by the solar radiation sensor 36, without respect to the detection results of the IR sensor 37.

[0076]

The inventors of this application find that the passenger's preference relating to the air amount blown by the blower relates to not only passenger thermal-feeling but also air-blowing noise and the like. If the air blowing amount is carefully controlled in accordance with the solar radiation thermal load in each detection area in the passenger compartment, the uncomfortable feeling given to the passenger may be increased.

[0077]

According to the above construction and operation, the same operational effect as in the second embodiment can be obtained. Further, the averaged air blowing amount is controlled in accordance with the total solar radiation amount, without respect to a solar radiation condition in each detection area of the passenger compartment. Therefore, uncomfortable feeling given to the passenger can be surely reduced.

[0078]

(Other Embodiments)

In the above-described embodiments, the IR sensor 37 is used

as a surface temperature detecting device in each detection area of the passenger compartment. However, for example, temperature detecting elements may be disposed around an inner surface of the passenger compartment in detection areas, respectively, without being limited to this manner. Incidentally, the IR sensor 37 can detect the surface temperatures in the plural detection areas more simply than the plural temperature detecting elements.

[0079]

Further, in the above embodiments, the control unit 30 learns the air-conditioning control characteristic. However, in a vehicle air conditioner that does not perform a learning control, a control unit may control an operation portion based on a surface temperature in each detection area of the passenger compartment.

[0080]

In the above-described second and third embodiments, the solar radiation sensor 36 is adopted. However, the total solar radiation thermal load may be calculated based on the average temperature of surface temperatures detected by the IR sensor 37.

[0081]

In the above embodiments, the air mixing door 22b and the blower 27 are used as the operation portion of the air conditioning unit 20. However, for example, the mode doors 22c, 22d, 22e may be used as the operation portion, without being limited to this manner. In this case, the air outlet mode is changed in accordance with the solar radiation condition. Further, a louver (not shown) may be used as the operation portion. In this case, a blowing

direction of conditioned air is changed in accordance with the solar radiation condition.

[Brief Description of the Drawing]

[FIG. 1] FIG. 1 is a schematic diagram showing a vehicle air conditioner 10 according to a first embodiment of the present invention.

[FIG. 2] FIG. 2 is a schematic diagram showing a temperature detecting method using an IR sensor 37.

[FIG. 3] FIG. 3 is a flow diagram showing an entire control process of a control unit 30.

[FIG. 4] FIG. 4 is a flow diagram showing an air mixing control operation at step S300 shown in FIG. 3.

[FIG. 5] FIG. 5 is a view showing a detection example of the IR sensor 37.

[FIG. 6] FIG. 6 is a map showing a learning of a set temperature.

[FIG. 7] FIG. 7 is a schematic diagram showing a main part of a vehicle air conditioner according to a second embodiment of the present invention.

[FIG. 8] FIG. 8 is a flow diagram showing a blower voltage control operation according to a third embodiment of the present invention.

[FIG. 9] FIG. 9(a) is a map for explaining a learning of a voltage applied to a blower, and FIG. 9(b) is a graph showing a control characteristic example of the voltage applied to the blower.

[Explanation of Numerals]

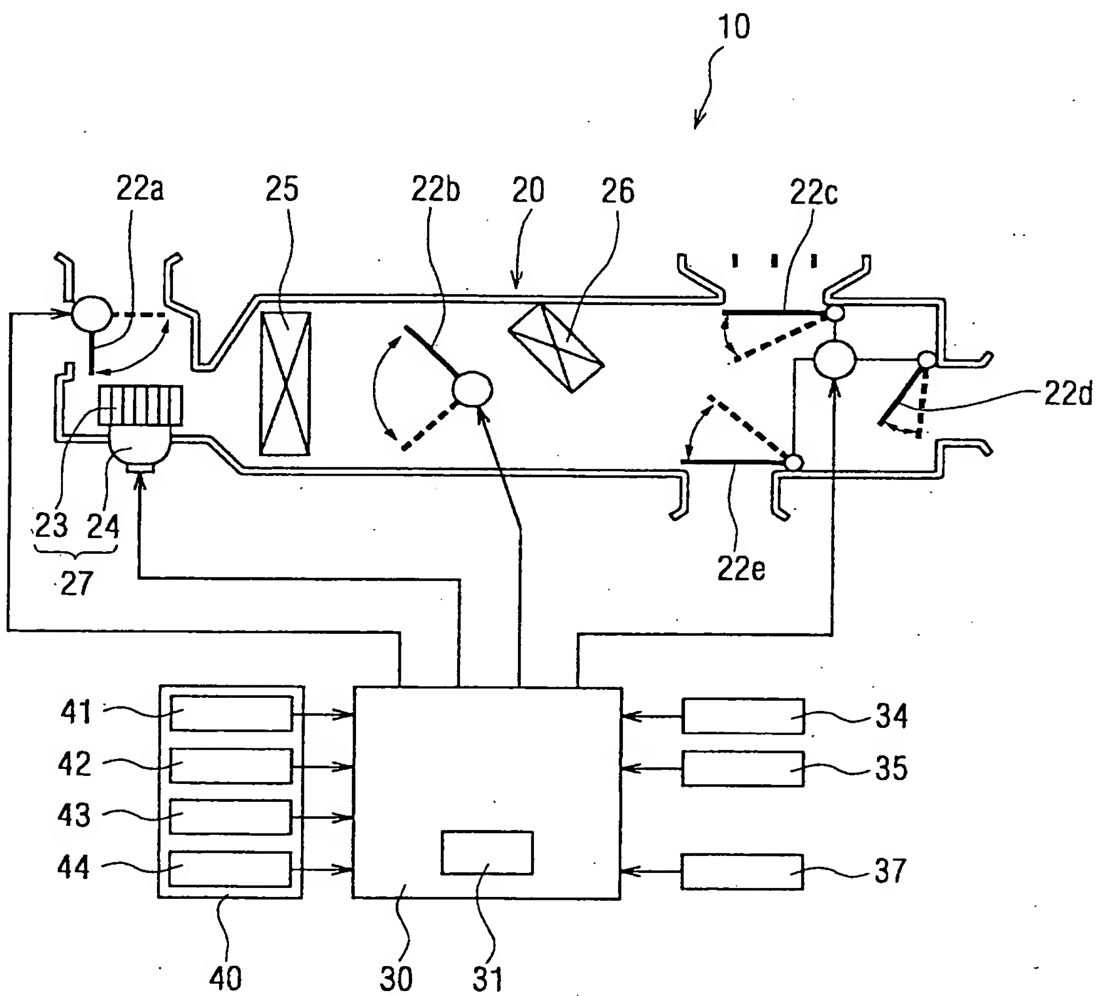
10 - a vehicle air conditioner, 20 - an air conditioning unit (air conditioning unit portion), 22b - an air mixing door (operation portion, air-outlet temperature changing device), 27 - a blower (operation portion), 30 - a control unit, 31 - a memory device

(control characteristic memory device), 34 - an outside air temperature sensor (environmental-condition detecting device), 36 - a solar radiation sensor (environmental-condition detecting device, solar radiation detecting device), 37 - an infrared rays sensor (IR sensor, environmental-condition detecting device, surface temperature detecting device), 43 - a temperature setting switch (control-value manual setting device), 44 - an air amount switch (control-value manual setting device)

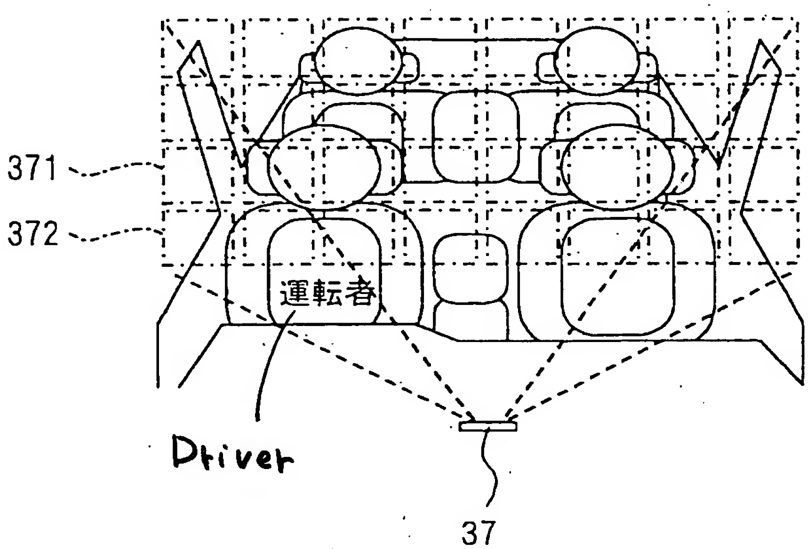
[Name of Document]　[Drawing]

【書類名】　図面

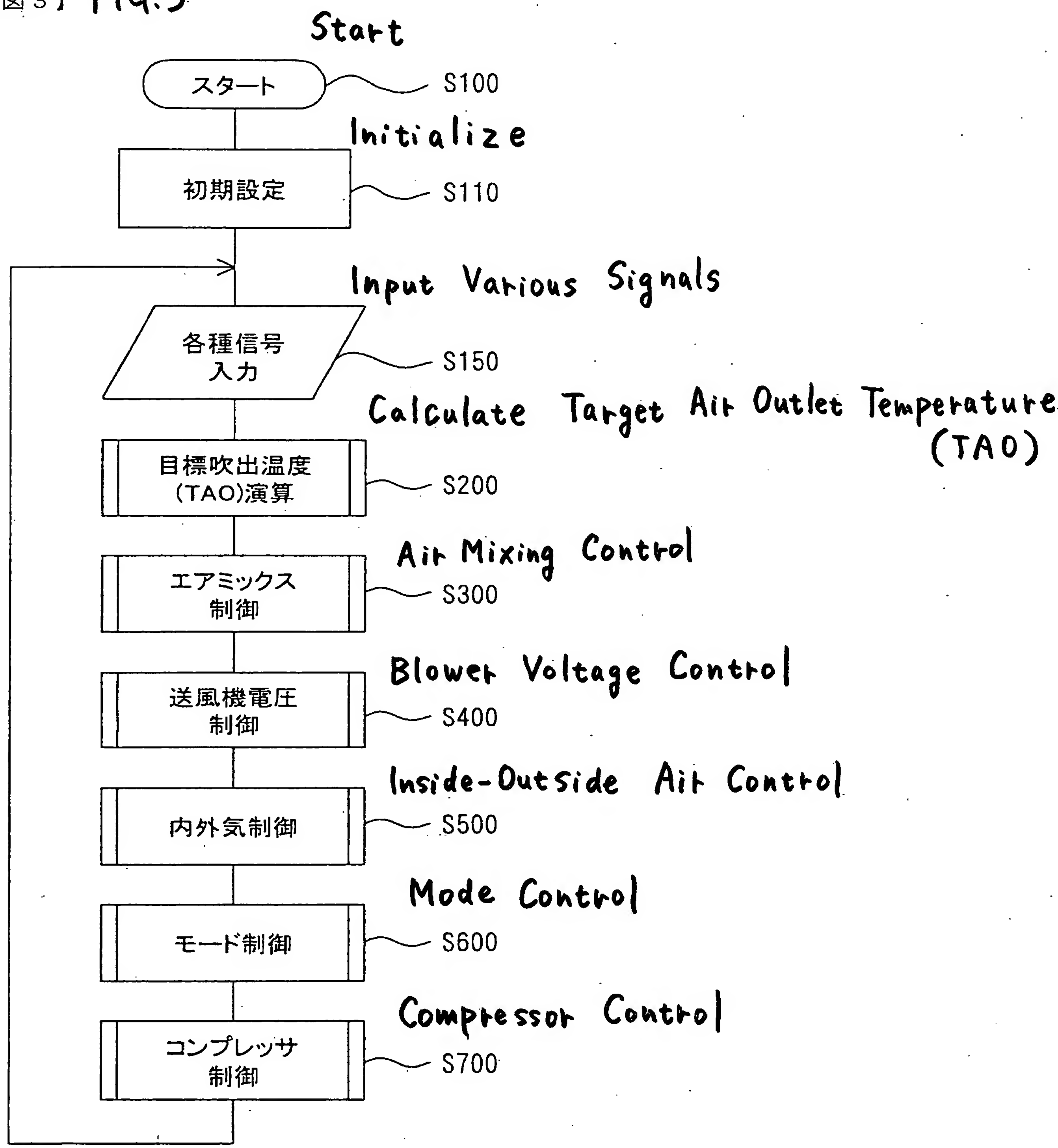
【図１】 FIG.1



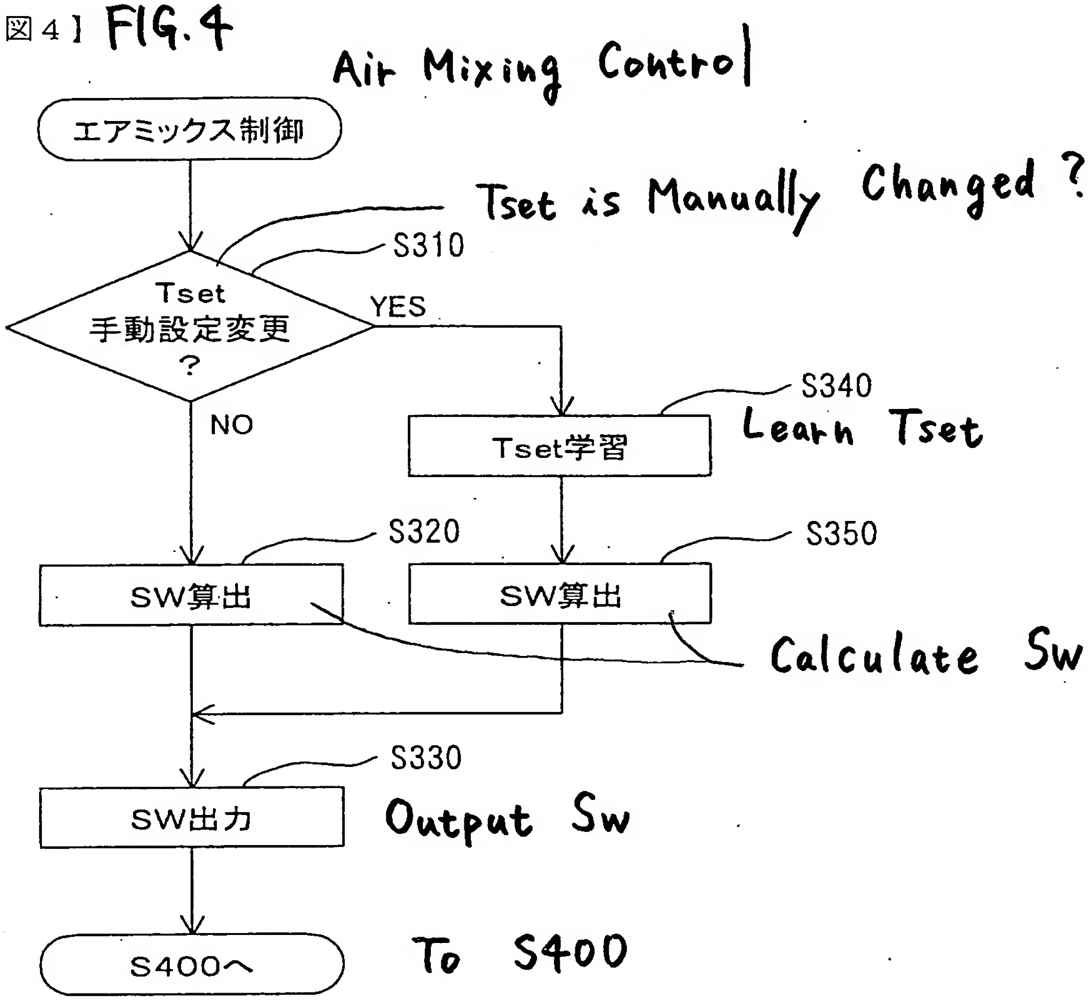
【図２】 FIG.2



【図３】 FIG.3


Start
スタート
S100
Initialize
初期設定
S110
Input Various Signals
各種信号
入力
S150
Calculate Target Air Outlet Temperature (TAO)
目標吹出温度
(TAO)演算
S200
Air Mixing Control
エアミックス
制御
S300
Blower Voltage Control
送風機電圧
制御
S400
Inside-Outside Air Control
内外気制御
S500
Mode Control
モード制御
S600
Compressor Control
コンプレッサ
制御
S700

【図４】 FIG.4

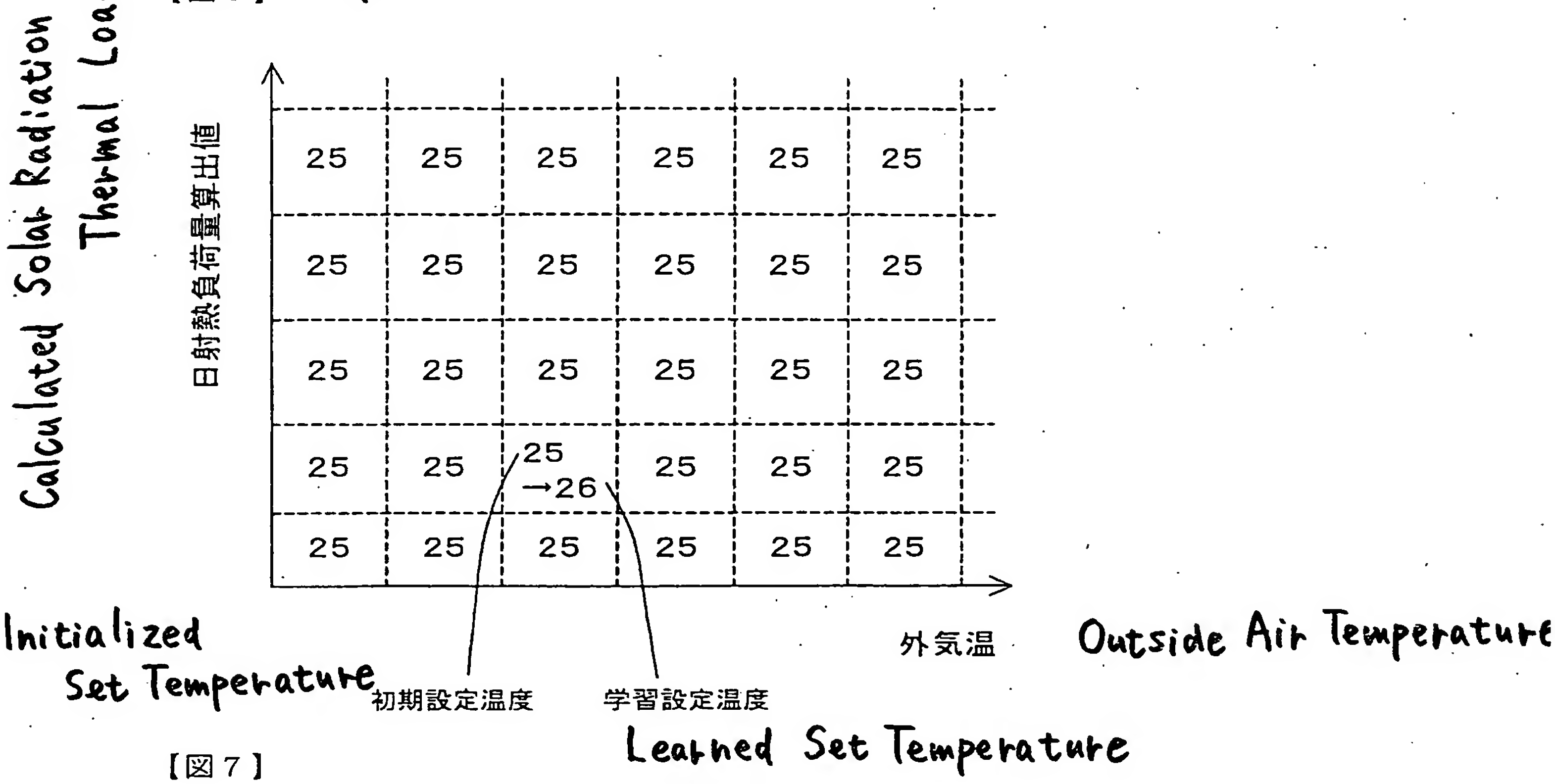


【図５】 FIG.5

(℃)

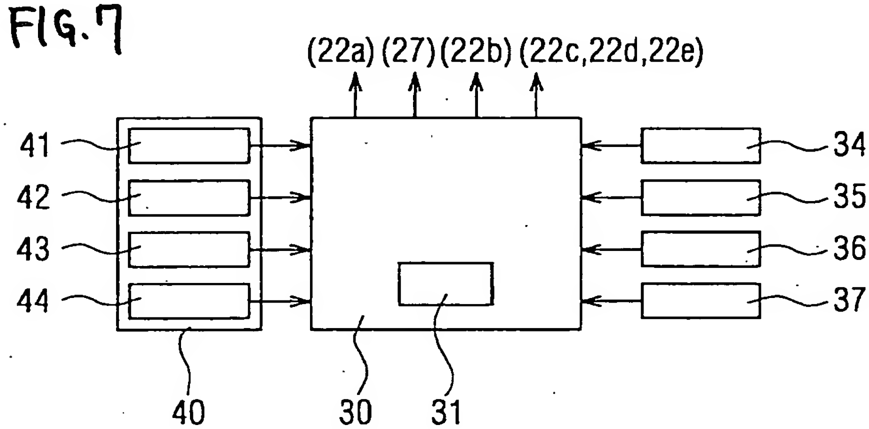
	28. 5	27. 6	26. 0	25. 0	26. 0	26. 5	24. 7	24. 0
	28. 2	26. 8	26. 2	25. 2	25. 6	27. 5	25. 5	24. 5
(371)	28. 7	27. 0	26. 1	25. 5	25. 4	27. 8	25. 8	24. 5
(372)	29. 0	28. 5	26. 8	25. 8	25. 2	27. 2	26. 0	24. 5

【図６】 FIG.6

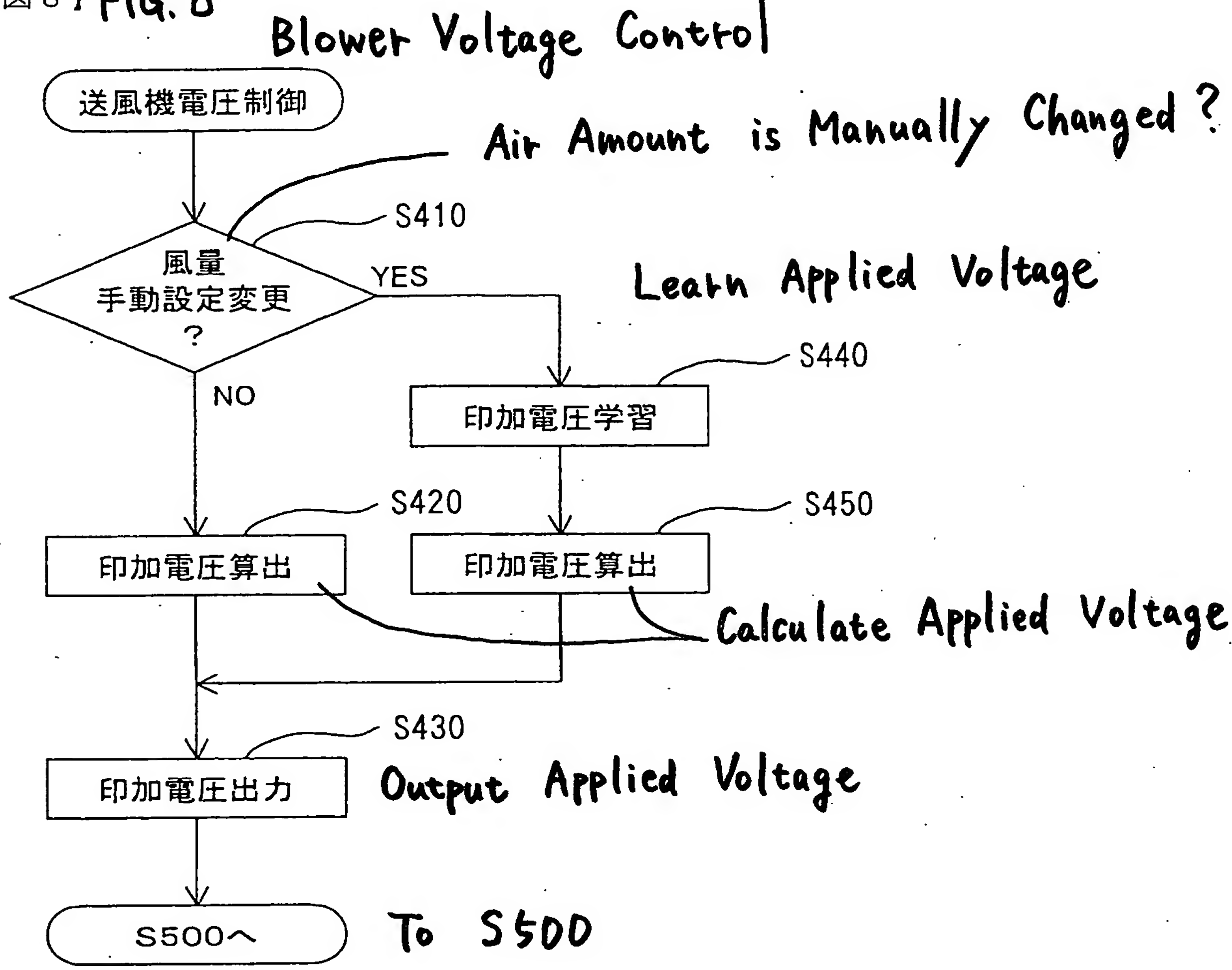


【図７】

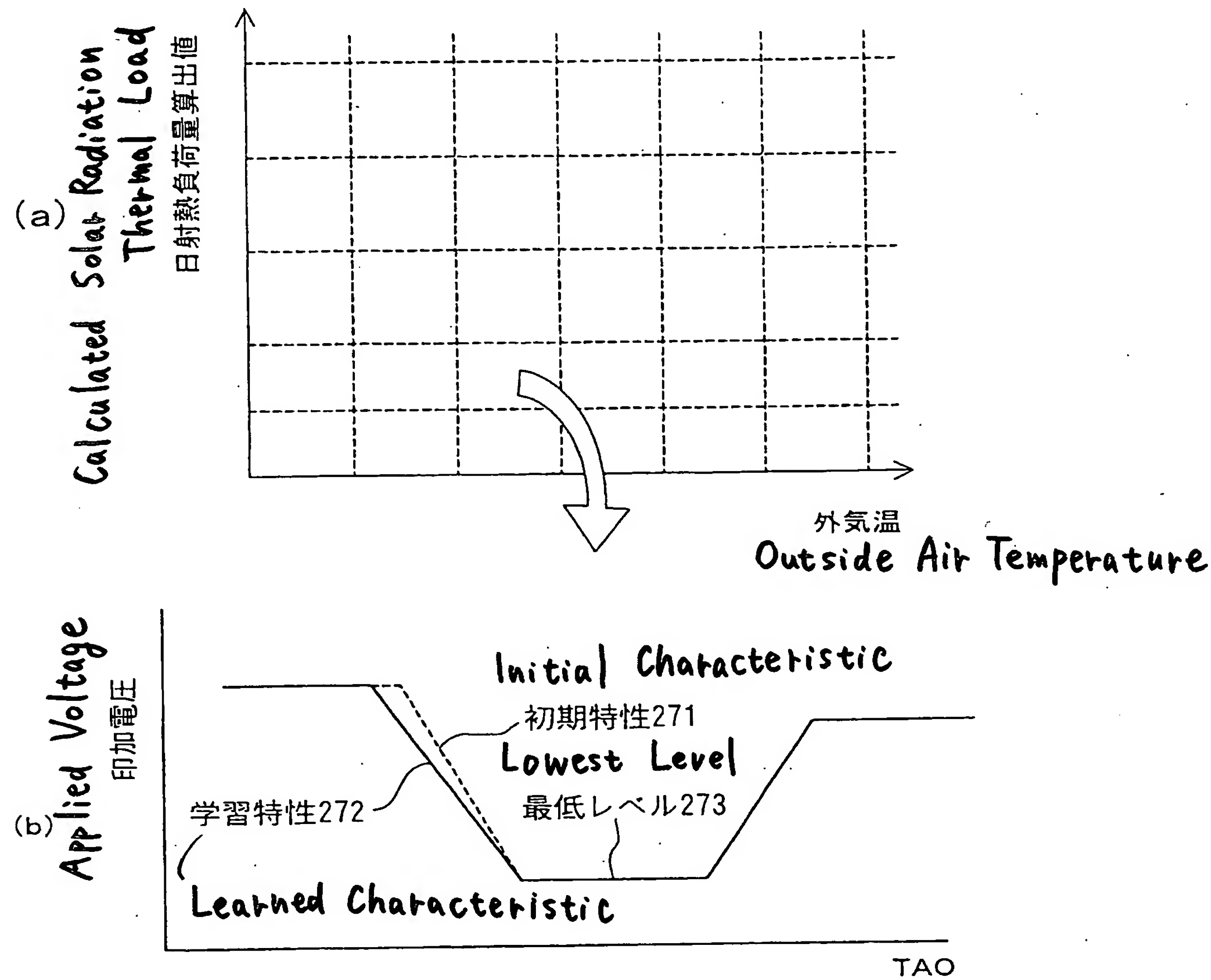
FIG.7



【図８】FIG. 8


Blower Voltage Control
送風機電圧制御
Air Amount is Manually Changed?
S410
風量
手動設定変更
？
YES
NO
Learn Applied Voltage
S440
印加電圧学習
S420
印加電圧算出
S450
印加電圧算出
Calculate Applied Voltage
S430
印加電圧出力
Output Applied Voltage
S500へ
To S500

【図９】 FIG. 9


(a)
Calculated Solar Radiation Thermal Load
日射熱負荷量算出値
外気温
Outside Air Temperature
(b)
Applied Voltage
印加電圧
Initial Characteristic
初期特性271
Lowest Level
最低レベル273
学習特性272
Learned Characteristic
TAO

[Name of the Document] ABSTRACT

[Abstract]

[Object] It is an object of the present invention to provide a vehicle air conditioner capable of reducing uncomfortable feeling given to a passenger regardless of a solar radiation condition.

[Solution] An inner surface temperature of a passenger compartment or a surface temperature of a passenger in each detection area of a passenger compartment is detected by an IR sensor 37. A control unit 30 determines a solar radiation amount and a solar radiation direction in the passenger compartment based on the detected surface temperature. The operation of an air mixing door 22b and the like are controlled based on the determined solar radiation amount and the determined solar radiation direction. Thus, uncomfortable feeling given to the passenger can be reduced regardless of the solar radiation condition.

[Selected Figure] FIG. 1